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# DISCOVERY OF THE SMALL JAPANESE CEDAR LONGHORNED BEETLE, *CALLIDIELLUM RUFIPENNE* (MOTSCHULSKY) (COLEOPTERA: CERAMBYCIDAE), IN LIVE ARBORVITAE IN CONNECTICUT

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*Abstract.*—The small Japanese cedar longhorned beetle, *Callidiellum rufipenne* (Motschulsky) (Coleoptera: Cerambycidae), was discovered principally in three cultivars of American arborvitae, *Thuja occidentalis* L., in four towns in Fairfield and New Haven Co. in southwestern Connecticut. Between September 1998 and March 1999, infestations of *C. rufipenne* were found in 102 (0.5%) of 20,000 cupressaceous plants that were inspected in garden centers, nurseries, landscaped areas, and the wild in Connecticut. Within 2 years of planting, 94 (92.2%) of infested plants had been balled and burlaped, which may have stressed them. Of the 102 plants, 101 (99%) were 0.9–2.1 m high arborvitae that averaged 6.3 beetles/plant, and the other one was yellow cedar, *Chamaecyparis nootkatensis* (D. Don) Sprach. Arrivals of beetles in wood material at ports of entry, increased international trade and travel, and the high abundance of potential hosts in coastal North America probably have facilitated introduction and establishment. Adults, life cycle, and damage of *C. rufipenne* are described briefly.

*Key Words:* Arborvitae, *Callidiellum*, Cerambycidae, *Chamaecyparis*, Coleoptera, Connecticut, Cupressaceae, *Juniperus*, larval damage, plant pest, state record, *Thuja occidentalis*

The small Japanese cedar longhorned beetle, *Callidiellum rufipenne* (Motschulsky) (Coleoptera: Cerambycidae), is best known as a borer of Japanese cedar, *Cryptomeria japonica* D. Don (Taxodiaceae), and Japanese cypress or Hinoki false cypress, *Chamaecyparis obtusa* (Siebold & Zuccarini) Endlicher (Cupressaceae) (Makihara 1984, Shibata 1994), which are important trees in Japanese plantations (Kobayashi 1985). Larvae of *C. rufipenne*, however, also tunnel into the wood of other species of Cupressaceae and rarely Pinaceae (Bates 1873, Gressitt 1951, Shiraki 1952, Campadelli and Sama 1988, Bahillo and Iturrondobeitia 1995). Shibata (1994) and others have suggested that *C. rufipenne* attacks only dead or dying wood of its coniferous hosts. Other species of *Callidiellum*, *C. cupressi* (Van Dyke) and *C. virescens* Chemsak and Linsley in the western United States (Chemsak and Powell 1964, Chemsak and Linsley 1966) and *C. flavosignatus* Pu and *C. villosulum* (Fairmaire) in China (Gressitt 1951, Pu 1991), also are restricted to conifers in the Cupressaceae, Pinaceae, and Taxodiaceae.

In May 1997, a single adult of *C. rufipenne* was collected on wild eastern red cedar, *Juniperus virginiana* L., at Manteo, Dare Co., North Carolina (E.R. Hoebeke, in litt.). This represented the first record of this

eastern Asian beetle in the wild in the United States. After the initial discovery of the lone adult, K. Ahlstrom (in litt.) reared additional adults from larvae collected in the wood of dead eastern red cedar at Manteo. Before its recent introduction into Italy (Campadelli and Sama 1988), Spain (Bahillo and Iturrondobeitia 1995), and this country, *C. rufipenne* had a distributional range of Russia (Sakhalin), Japan (including the Ryukyu Islands), Korea, Taiwan, and northeastern China (e.g., Gressitt 1951, Duffy 1968, Makihara et al. 1989). Gressitt (1951) suggested that *C. rufipenne* probably was introduced into Taiwan. Port inspectors have repeatedly intercepted this beetle in dunnage and other wood products shipped to New Zealand (Bain 1974, 1977), the United States (Mumford 1965, 1966, 1967; Girard 1968, 1969, 1971, 1972a, 1972b, 1973, 1974; USDA 1979, 1980, 1981, 1982, 1984), and other countries.

Here we report the discovery of *C. rufipenne* in Connecticut, document its infestation of live plants, mainly American arborvitae or northern white cedar, *Thuja occidentalis* L., and briefly describe its life history and the appearance of damage. We initiated this and additional studies because *C. rufipenne* may pose a threat to the nursery industry and to northern forests. Arborvitae are important to the nursery trade because they are popular ornamental shrubs grown widely and planted especially near homes and commercial buildings. In addition, northern white cedars are an integral part of some forests in northeastern and north-central North America.

## Materials and Methods

Adult records from Connecticut are based on inspecting plants for larval injury and then removing or rearing beetles from plants with damage. We extracted adults from wood mainly between late September 1998 and February 1999 by finding holes (the eventual adult exit routes that had been plugged with chewed wood by larvae) in branches and then by splitting the wood to reveal the individual adults in their pupal chambers. Between November 1998 and March 1999, additional infested arborvitae (about 80% of all infested plants) were transported from garden centers or landscaped areas, mostly residential yards in Fairfield and New Haven Co., to two outdoor enclosures with double screening at Lockwood Farm, Hamden, New Haven Co., Connecticut. In late March, branches that appeared to be uninfested were pruned from these shrubs and burned in accordance with state regulations. The remaining wood that had evidence of larval boring was divided into two equal groups. Wood of each of the shrubs in one lot was placed in a sealed white plastic drum (18.9 liters) in an environmental chamber adjusted to 21 ± 1°C and to a 15L:9D photoperiod. The remainder of the wood was put into screened cages of various sizes in one of the outdoor screened houses. Adults were collected from drums or cages every 3–7 days until emergence ended.

Data for infestations of *C. rufipenne* discovered by federal inspectors at ports of entry between 1964 and 1982 (Mumford 1965, 1966, 1967; Girard 1968, 1969, 1971, 1972a, 1972b, 1973, 1974; USDA 1979, 1980, 1981, 1982, 1984) were used in Fig. 1. Yearly records were based on the fiscal year, which changed during the mid-1970's. Between 1964 and 1982, *C. rufipenne* had a quarantine status of an actionable pest. In 1982, the Animal and Plant Health Inspection Service (APHIS) changed its quarantine status from an actionable to a non-reportable pest (J. Cavey, in litt.), which resulted in a rapid decrease in records of its interception. In 1998, *C. rufipenne* again became an actionable pest.

Voucher specimens are deposited at the Connecticut Agricultural Experiment Station, New Haven; Cornell University, Ithaca, New York; National Museum of Natural History, Smithsonian Institution, Washington, D.C.; and Essig Museum of Entomology, University of California, Berkeley, California.

Table 1. Location and characteristics of live arborvitae, *Thuja occidentalis*, infested by the small Japanese cedar longhorned beetle, *Callidiellum rufipenne*, in Connecticut during 1998.

| Location of Infested Plants | | | | | No. Beetles | |
|---|---|---|---|---|---|---|
| County | Town | Variety of Arborvitae | Height (m) | No. Infested | Mean | Range |
| Fairfield | Greenwich | Smaragd | 1.8–2.1 | 7 | 4.4 | 2–9 |
| Fairfield | Greenwich/Stamford[1] | Smaragd | 1.5–1.8 | 4 | 10.3 | 2–27 |
| Fairfield | Stamford | Brandon | 1.8–2.1 | 2 | 4.0 | 3–5 |
| Fairfield | Stamford | Smaragd | 1.5–1.8 | 26 | 11.1 | 2–37 |
| Fairfield | Stamford/Greenwich[1] | Smaragd | 1.5–1.8 | 16 | 5.5 | 2–11 |
| New Haven | Milford | Nigra | 1.5–1.8 | 2 | 2.0 | |
| New Haven | Milford | Smaragd | 0.9–1.5 | 8 | 1.9 | 1–3 |
| New Haven | Milford | Smaragd | 1.2–1.8 | 31 | 4.5 | 1–16 |
| New Haven | North Haven | Smaragd | 1.5–1.8 | 5 | 3.4 | 1–9 |

[1] In 1998, these arborvitae initially were at the garden center in the town listed first, and then, usually in spring of the same year, they were planted in yards in the town listed second.

## Results and Discussion

Infestations in Connecticut.—On 22 September 1998, one adult of *C. rufipenne* was found in a branch of a emerald green arborvitae, *T. occidentalis* 'Smaragd', planted in spring 1998 near a small factory in Milford, New Haven Co. Subsequent inspection of the planting of 42 arborvitae at this site revealed 7 live plants (16.7% of the total) with injury from larval boring. The 42 arborvitae planted by the factory were purchased at a nearby garden center that also had infested arborvitae that had not been sold. This find represents the second North American record of this beetle outside a port of entry, and the first from a live arborvitae that visually appeared to be healthy. In 1967, an inspector at a port in the United States did intercept *C. rufipenne* in dunnage of a *Thuja* species on a cargo ship (Girard 1968).

Between autumn 1998 and spring 1999, state inspectors found 102 (0.5% of total) infested plants among 20,000 cupressaceous shrubs or trees examined in garden centers, nursery fields, landscaped areas, and the wild throughout Connecticut. Plants infested with *C. rufipenne* were located mainly in four garden centers and in nearby residential areas with arborvitae that recently had been purchased from the garden centers (see Table 1 for the locations). Of 102 infested plants, 100 (98.0%) had been imported from western North America, and 94 (92.2%) had been balled and burlaped within 2 years of inspection for *C. rufipenne*. Thorough examination of nursery fields at the points of origin in British Columbia (J. Bell and B. Gill, in litt.) and Oregon (R. Westcott, in litt.) and inspection of shipments from the western North America in 1999 did not reveal any damage or specimens of *C. rufipenne*. The plants with *C. rufipenne* apparently became infested in Connecticut; however, the origin and time of introduction are unknown.

Of the 102 infested plants, 101 (99.0%) were arborvitae (Table 1), and one was a yellow cedar, *Chamaecyparis nootkatensis* (D. Don) Spach. Among the 101 infested arborvitae of three cultivars, 97 (96.0%) were the variety 'Smaragd', which currently is the most widely grown and planted arborvitae in Connecticut. Infested arborvitae had between 1 and 37 beetles, and ranged in height from 0.9 to 2.1 m. In all, 632 beetles developed in the wood of the 101 arborvitae (mean = 6.3 live beetles/plant), and 6 in that of yellow cedar. An unknown number of arborvitae that may have been infested by *C. rufipenne* at the four garden centers were sold and probably planted in southwestern Connecticut.

Even though most infested plants that

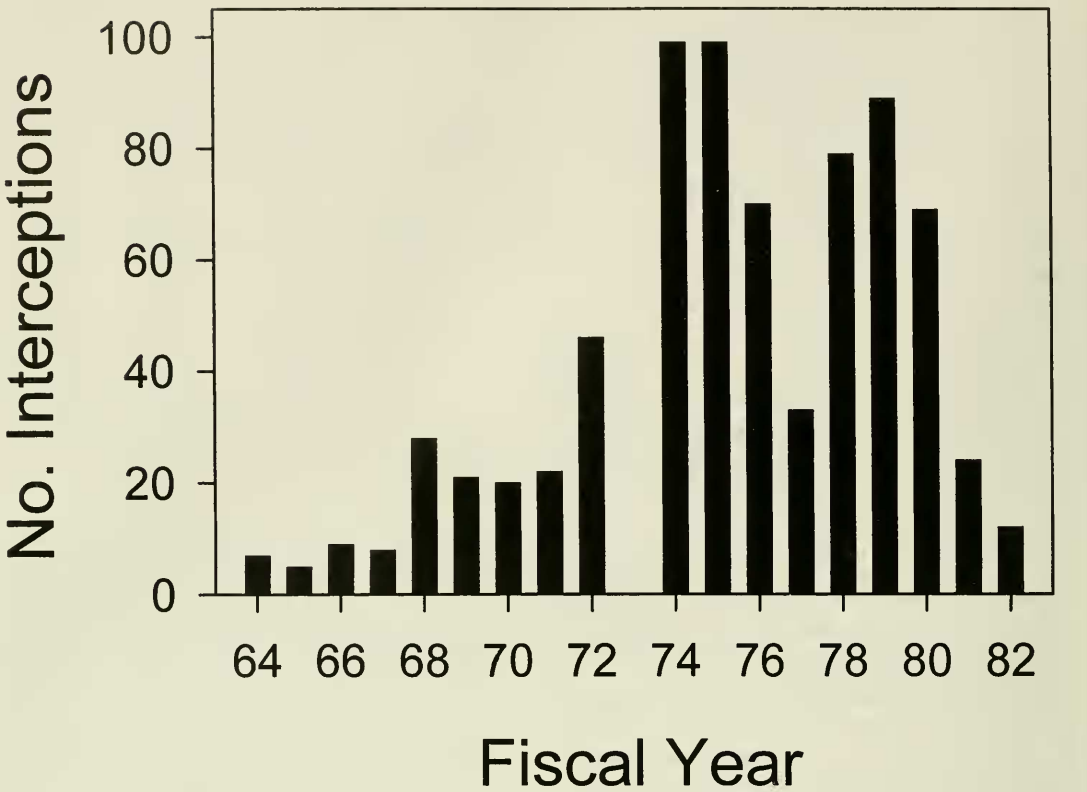


Fig. 1. Frequency of interceptions of the small Japanese cedar longhorned beetle, *Callidiellum rufipenne,* at ports of entry in the United States between 1964 and 1982. The change in the fiscal year in the early 1970's apparently caused some inconsistencies in compilation of data between 1973 and 1975.

were balled and burlaped appeared healthy, they may have been susceptible to attack by *C. rufipenne* because they were stressed by root and branch breakage and possibly inadequate watering before, during, and after shipment to Connecticut. Furthermore, these arborvitae occasionally were infested by bark beetles (Scolytidae), such as *Phloeosinus canadensis* Swaine and *Polygraphus rufipennis* (Kirby).

Factors contributing to accidental introduction and establishment.—The small Japanese cedar longhorned beetle has repeatedly been intercepted by federal and state inspectors at ports of entry in the United States (Mumford 1965, 1966, 1967; Girard 1968, 1969, 1971, 1972a, 1972b, 1973, 1974; USDA 1979, 1980, 1981, 1982, 1984; R. Penrose, in litt.). In most cases, the intercepted beetles were associated with dunnage or other wooden material from eastern Asia. In Vancouver, British Columbia, in 1927, *C. rufipenne* was reared from imported wood of Japanese origin (Leech 1949). Hatch (1971) recorded another specimen from Seattle, Washington, but this beetle, too, was likely associated with an imported wood product.

Between 1964 and 1982, when federal inspectors actively reported infestations of *C. rufipenne,* they repeatedly discovered them in imported wood material (Fig. 1). During these years, infestations were found in dead wood, especially dunnage, in 21 states in the United States and in Puerto Rico (Mumford 1965, 1966, 1967; Girard 1968, 1969, 1971, 1972a, 1972b, 1973, 1974; USDA 1979, 1980, 1981, 1982, 1984). Although *C. rufipenne* was not discovered at ports of entry in Connecticut, it

was found in ports of the nearby states of New Jersey, New York, and Pennsylvania. In coastal counties in Connecticut and nearby states, potential hosts abound in residential areas and forests. In particular, overmature, often dead and dying trees of *J. virginiana* are numerous in successional areas along major highways and in regrowth forests. We suggest that the frequency of arrivals of *C. rufipenne* in imported wood, increased international trade and travel, and the high abundance of potential hosts near coastal areas probably have facilitated the accidental introduction and establishment of *C. rufipenne* in the United States.

Brief description of adult appearance, life history, and damage.—Males are iridescent deep blue with a single brownish red to red patch at the anterolateral corner of the upper surface of each elytron. The females (Fig. 2) have entirely reddish brown elytra and a reddish abdomen. The antennae of males are longer than the body, whereas those of females are shorter, about ⅔ to ¾ the length of the body. Thus, the sexes can be separated by both color and antennal length. When they are reared from arborvitae, adults vary from 5–13 mm in length.

The life history of *C. rufipenne* (Shibata 1994, in litt.; Maier 1999; Y. Soma, in litt.) is similar to that of other species of *Callidiellum* (Chemsak and Powell 1964, Nakamura and Kojima 1981). Adults of *C. rufipenne* emerge from wood in spring and soon mate on the host. Females of *C. rufipenne* then lay eggs singly or in small groups in cracks or crevices in stems or bark. After hatching, larvae bore into the cambium and phloem. They expand their feeding tunnel until they become full-grown (Fig. 3) in late summer. After feeding is completed, larvae bore into the sapwood and carve an ellipsoidal pupal cell. The pupal chamber is connected to the surface of a branch by an exit tunnel (Fig. 4) that is oval in cross-section. Larvae plug the eventual exit route with fragments of chewed wood. They pupate in late summer or early fall, and adults eclose within 2–3 weeks, usually in the autumn. Adults remain in the pupal cell until the following spring when they remove the plug to the pupal cell and emerge. In Connecticut, *C. rufipenne* has one generation per year. In Japan, the life cycle also usually requires 1 year. In some northern regions of Japan, however, it may require 2 years to complete the life cycle (Y. Soma, in litt.).

In live arborvitae, injury from larval boring becomes most obvious between late summer and the following spring when the bark of small arborvitae often splits to reveal the sinuous larval tunnels (Fig. 5). The larval gallery is packed with frass, which apparently is also mixed with chewed wood fragments. In some cases, these tunnels may encircle branches and, thereby, disrupt the flow of water and nutrients within the plant. The material packed in the larval gallery has both light and dark particles, giving it a "salt-and-pepper" look.

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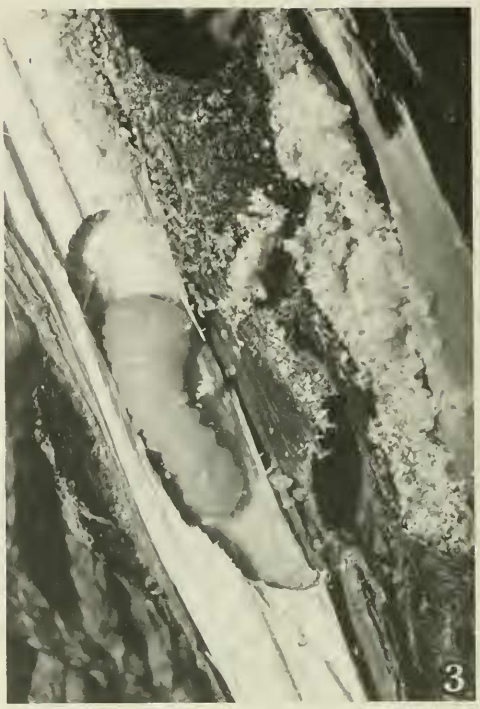




Figs. 2–5. Small Japanese cedar longhorned beetle, *Callidiellum rufipenne*. 2, Adult female, 12 mm in length. 3, Full-grown larva exposed after removal of bark of arborvitae, 13 mm in length. 4, Larva in its ellipsoidal pupal cell; note the pupal plug of chewed wood fragments. 5, Branch injury caused by larval boring. Arrows show frass and chewed wood exposed after the bark splits in late summer.

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## Literature Cited

Bahillo, P. and J. C. Iturrondobeitia. 1995. Primera cita de *Callidiellum rufipenne* (Motschulsky, 1860) para la Península Ibérica (Coleoptera: Cerambycidae). Boletín de la Asociación Española de Entomologica 19(3–4): 204.

Bain, J. 1974. Overseas wood- and bark-boring insects intercepted at New Zealand ports. New Zealand Forest Service (Wellington) Technical Paper No. 61, 24 pp.

———. 1977. Overseas wood- and bark-boring insects intercepted at New Zealand ports. New Zealand Forest Service (Wellington) Technical Paper No. 63, 28 pp.

Bates, H. W. 1873. On the longicorn Coleoptera of Japan. Annals and Magazine of Natural History, including Zoology, Botany, and Geology (4th series) 12: 193–201.

Campadelli, G. and G. Sama. 1988. Prima segnalazione per l'Italia di un cerambicide giapponese: *Callidiellum rufipenne* Motschulsky. Bollettino dell'Istituto di Entomologia «Guido Grandi» dell'Università di Bologna 43: 69–73.

Chemsak, J. A. and E. G. Linsley. 1966. The genus *Callidiellum* in North America (Coleoptera: Cerambycidae). Pan-Pacific Entomologist 42: 151–155.

Chemsak, J. A. and J. A. Powell. 1964. Observations on the larval habits of some Callidiini with special reference to *Callidiellum cupressi* (Van Dyke) (Coleoptera: Cerambycidae). Journal of the Kansas Entomological Society 37: 119–122.

Duffy, E. A. J. 1968. A Monograph of the Immature Stages of Oriental Timber Beetles (Cerambycidae). The British Museum (Natural History), London, England, 434 pp.

Girard, D. H., compiler. 1968. List of intercepted plant pests, 1967 (pests recorded from July 1, 1966, through June 30, 1967). United States Department of Agriculture, Agricultural Research Service, Plant Quarantine Division, Hyattsville, Maryland. ARS 82-6-2, 76 pp.

———. 1969. List of intercepted plant pests, 1968 (pests recorded from July 1, 1967, through June 30, 1968). United States Department of Agriculture, Agricultural Research Service, Plant Quarantine Division, Hyattsville, Maryland. ARS 82-6-3, 86 pp.

———. 1971. List of intercepted plant pests, 1969 (pests recorded from July 1, 1968, through June 30, 1969). United States Department of Agriculture, Agricultural Research Service, Plant Quarantine Division, Hyattsville, Maryland. ARS 82-6-4, 77 pp.

———. 1972a. List of intercepted plant pests, 1970 (pests recorded from July 1, 1969, through June 30, 1970). United States Department of Agriculture, Animal and Plant Health Inspection Service, Hyattsville, Maryland. APHIS 82-1, 85 pp.

———. 1972b. Addendum to list of intercepted plant pests, 1970 (pests recorded from July 1, 1969, through June 30, 1970). United States Department of Agriculture, Animal and Plant Health Inspection Service, Hyattsville, Maryland. APHIS 82-1 (we suspect that this issue should have been labeled 82–2), 13 pp.

———. 1973. List of intercepted plant pests, 1971 (pests recorded from July 1, 1970, through June 30, 1971). United States Department of Agriculture, Animal and Plant Health Inspection Service, Hyattsville, Maryland. APHIS 82-3, 81 pp.

———. 1974. List of intercepted plant pests, 1972 (pests recorded from July 1, 1971, through June 30, 1972). United States Department of Agriculture, Animal and Plant Health Inspection Service, Hyattsville, Maryland. APHIS 82-4, 97 pp.

Gressitt, J. L. 1951. Longicorn beetles of China. Longicornia 2: 1–677.

Hatch, M. H. 1971. The beetles of the Pacific Northwest. Part V. Rhipiceroidea, Sternoxi, Phytophaga, Rhynchophora, and Lamellicornia. University of Washington (Seattle) Publications in Biology 16: 1–662.

Kobayashi, F. 1985. Occurrence and control of wood-injuring insect damage in Japanese cedar and cypress plantations. Zeitschrift für angewandte Entomologie 99: 94–105.

Leech, H. B. 1949. Introduction into British Columbia of two species of Japanese Cerambycidae (Coleoptera). Proceedings of the Entomological Society of British Columbia 45: 26.

Maier, C. T. 1999. Beetle thought to attack only dead

wood found in live arborvitae in Connecticut. Frontiers of Plant Science 51(2): 4–5.

Makihara, H. 1984. Cerambycid beetles in Japan (5). Forest Pests 33: 53–54.

Makihara, H., A. Saito, Y.-I. Chu, M. Hayashi, and S. Nakamura. 1989. A list of cerambycid beetles from Taiwan (III). Subfamily Cerambycinae. Chinese Journal of Entomology 9: 289–300.

Mumford, B. C., compiler. 1965. List of intercepted plant pests, 1964 (pests recorded from July 1, 1963, through June 30, 1964). United States Department of Agriculture, Agricultural Research Service, Plant Quarantine Division, Hyattsville, Maryland, 76 pp.

———. 1966. List of intercepted plant pests, 1965 (pests recorded from July 1, 1964, through June 30, 1965). United States Department of Agriculture, Agricultural Research Service, Plant Quarantine Division, Hyattsville, Maryland, 88 pp.

———. 1967. List of intercepted plant pests, 1966 (pests recorded from July 1, 1965, through June 30, 1966). United States Department of Agriculture, Agricultural Research Service, Plant Quarantine Division. ARS 82-6-1, 86 pp.

Nakamura, S. and K. Kojoma. 1981. Immature stages of Taiwanese cerambycid beetles (Coleoptera: Cerambycidae) with notes on their habit. Kontyû (Tokyo) 49: 155–165.

Pu, F.-J. 1991. Notes on the genus *Callidiellum* Linsley from China (Coleoptera: Cerambycidae). Acta Entomologica Sinica 43: 341–343. (In Chinese.)

Shibata, E. 1994. Population studies of *Callidiellum rufipenne* (Coleoptera: Cerambycidae) on Japanese cedar logs. Annals of the Entomological Society of America 87: 836–841.

Shiraki, T. 1952. Catalogue of injurious insects in Japan. Economic and Scientific Section, Natural Resources Division. Preliminary Study No. 71 (Volume IV). Prepared for Supreme Commander for the Allied Powers, Tokyo, Japan.

USDA. 1979. List of intercepted plant pests (pests recorded from July 1, 1973, through September 30, 1977). United States Department of Agriculture, Animal and Plant Health Inspection Service, Hyattsville, Maryland. APHIS 82-5, 568 pp.

———. 1980. List of intercepted plant pests (pests recorded from October 1, 1977 through September 30, 1978). United States Department of Agriculture, Animal and Plant Health Inspection Service, Hyattsville, Maryland. APHIS 82-6, 178 pp.

———. 1981. List of intercepted plant pests (pests recorded from October 1, 1978 through September 30, 1979). United States Department of Agriculture, Animal and Plant Health Inspection Service, Hyattsville, Maryland. APHIS 82-7, 171 pp.

———. 1982. List of intercepted plant pests. Fiscal years 1980 and 1981. United States Department of Agriculture, Animal and Plant Health Inspection Service, Hyattsville, Maryland. APHIS 82-8, 476 pp.

———. 1984. List of intercepted plant pests. Fiscal year 1982. United States Department of Agriculture, Animal and Plant Health Inspection Service, Hyattsville, Maryland. APHIS 82-9, 195 pp.